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(71) Applicant *(for all designated States except US)*: MERI-MATE LIMITED [GB/GB]; Wester Gourdie Industrial Estate, Dundee DD2 7NJ (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : OKHAI, Aziz, A. [GB/GB]; Meri-Mate Limited, Wester Gourdie Industrial Estate, Dundee DD2 7NJ (GB).

(74) Agent: FITZPATRICKS; 4 West Regent Street, Glasgow G2 1RS (GB).

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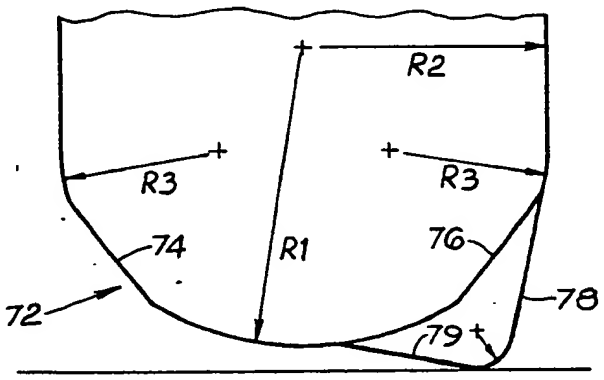
(54) Title: IMPROVEMENTS IN OR RELATING TO PLASTICS CONTAINERS



(57) Abstract

A plastics container, such as a bottle, includes a generally convex base portion (72) having a plurality of stabilising feet (78) projecting downwardly therefrom and spaced around the circumference thereof. The fundamental radius (R1) of the base portion (72) is greater than the radius (R2) of the body of the container and its resistance to deformation by internal pressure is enhanced by the provision of spurs, formed by the bottom surfaces (79) of the feet (78), extending radially inwards towards the centre of the base portion and terminating at or adjacent to said centre and/or by one or more frusto-conical portions (74, 76) superimposed upon the base portion (78).

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IMPROVEMENTS IN OR RELATING TO PLASTICS CONTAINERS

Description

The present invention relates to improved plastics containers and particularly to improvements in blow moulded plastic bottles for use as containers for pressurised liquids such a carbonated beverages.

The use of blow moulded bottles as containers for pressurised liquids such as carbonated soft drinks, beers, ciders etc. presents a number of problems. The principal problem is that the internal pressure generated by such bottles tends to distort the thin, flexible walls of a blow moulded bottle. This applies particularly to the base portion of the bottle.

Previously, this problem has been obviated by the use of a hemispherical base which allows the pressure to be distributed as evenly as possible. Such a base is, however, inherently unstable, and some means is required to allow the bottle to be free-standing. One approach is to attach a basecup to the hemispherical base but this obviously increases the manufacturing costs. There are also problems with adhesion and inaccurate positioning of the basecup may result in a bottle which does not stand vertically.

Accordingly, attempts have been made to produce a one-piece blow moulded bottle which is usable with pressurised liquids.

One such bottle is shown in Fig. 1 and includes a hemispherical base 2 (ie. a base having its radius of curvature equal to the radius of the bottle) with a number of stabilising feet 4 blown out therefrom. This design also has a number of associated problems. Since the base is fully hemispherical, the feet have to be very deep to project below the bottom of the base, requiring a significant increase in the weight of the bottle and

resulting in the effective base diameter d_1 being very much less than the diameter of the bottle d_2, leading to instability. The bottle is also liable to stress cracking owing to the depth of the feet 4 and also to the fact that the area of relatively weak unoriented plastics material around the centre of the base extends approximately half way along the lower surface of the feet 4.

It is an object of the present invention to obviate or mitigate the aforesaid disadvantages.

Accordingly, the present invention provides a plastics container comprising a generally cylindrical body portion and a generally convex base portion having a plurality of stabilising feet projecting downwardly therefrom and spaced around the circumference thereof, wherein the fundamental radius of curvature of said base portion is greater than the radius of said body portion, and further including means for increasing the resistance of said base portion to deformation due to internal pressure, said means comprising spurs, formed by the bottom surfaces of said stabilising feet, extending radially inwards towards the centre of said base portion and terminating at or adjacent to said centre and/or at least one frusto-conical portion superimposed upon said base portion.

Preferably, the bottom surfaces of said spurs each comprise, in radial cross-section, a generally straight-line portion extending radially inwards and merging with said generally convex base portion adjacent the centre thereof.

Preferably also, said base portion, in transverse cross-section, comprises a generally convex wall and each of said frusto-conical portions comprises a pair of straight-line portions, disposed symmetrically about the central axis of the container, superimposed upon said convex wall.

Preferably also, said base portion, in transverse cross-section, is generally part-elliptical, having bottom arcuate portion of radius greater than the radius of said body portion and first and second peripheral arcuate portions of radius less than the radius of said body portion.

Alternatively, said base portion, in transverse cross-section, is generally part-circular, comprising an arc of radius greater than the radius of said body portion.

Preferably also, the container further includes an upwardly concave portion located at the centre of said base portion.

Preferably also, the stabilising feet are generally U-shaped in section perpendicular to their radial axis and radiused into the base portion.

Preferably also, the number of said stabilising feet is in the range 7 to 12. It is particularly preferred that the number of feet is an odd number.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a sectional view of a known blow moulded bottle;

Fig. 2 is a plan view of the base of a container having an elliptical base;

Fig. 3 is a section on line A-A of Fig. 2;

Fig. 4 is a sectional perspective view on line B-B-B of Fig. 2;

Fig. 5 is a sectional view of a foot of the base;

Figs. 6 and 7 are sections on lines C-C and D-D of Fig. 5; and

Figs. 8 to 12 show various embodiments of the invention.

Referring now to Figs. 2 and 3 of the drawings, a container, such as a bottle comprises a substantially

cylindrical body portion 6, a suitable neck (not shown) and a base portion 8. The base portion 8 is generally convex (ie. part-spherical or ellipsoid) and has a pluraltiy of stabilisng feet 10 projecting downwardly therefrom and spaced around the circumference.

As is best seen in Fig. 3 in section, the shape of the base 8 is described by a segment of an arc having a radius of curvature (the fundamental radius) greater than the radius of the cylindrical body 6 of the bottle. The radius and centre of curvature preferably vary towards the periphery of the bottle so that the wall of the base portion 8 is semi-elliptical; ie. it becomes vertical at the point 12 where the base portion 8 meets the body portion 10. Thus, the base portion 8 of the bottle is not a full hemisphere. This is advantageous since the feet 10 need not be so deep as with a hemispherical base (the broken line 14 shows the line of an equivalent hemispherical base for comparison, see also Fig. 1), reducing the weight of the bottle and increasing the strength of the feet. The area of unoriented material around the centre of the base is also decreased.

A further advantage associated with the relatively shallow feet 10 is that the point of contact of each foot 10 with a supporting surface may be made closer to the periphery of the base 8 so that the effective base diameter is increased. That, is the ratio $d_3:d_4$ (Fig. 3) is greater than $d_1:d_2$ (Fig. 1), so that the stability of the bottle is improved.

Normally, when pressurised liquid is contained in a sealed container of flexible material, the internal pressure will tend to cause the container to assume a spherical shape. In this case, the shape of the base need not be perfectly spherical since the pressure on the sidewalls equalises the pressure on the base to a certain extent, so tending to resist deformation by the internal pressure.

Preferably, the ratio of the fundamental radius of curvature of the base to the radius of the bottle is in the range 1.2 to 2.0.

The shape of the feet 10 themselves may vary but should generally be rounded to distribute the internal pressure as evenly as possible and, as explained above, it is desirable that the supporting point be as close as possible to the periphery of the base 8.

A preferred form of the feet 10 which fulfills the above criteria is shown in the drawings and their overall shape is best seen in the perspective view of Fig. 4, wherein the dashed and dotted lines 16 correspond to the line along which the right-hand foot 18 has been cut (ie. the radial axis) and dashed lines 20 correspond to the line through which the base has been cut at the left hand side (ie. the mid-point between adjacent feet). These lines also correspond to lines 16 and 20 in Fig. 2.

Fig. 5 shows a foot 10 in section along its radial axis. In this view, the foot 10 comprises a substantially straight portion 22 depending from point 12 and sloping slightly inwards from the vertical (angle E_1, approximately 5^o). The straight portion 22 is tangent to an arc 24 (centre of curvature 26) which extends to the point of contact with a supporting surface. Thereafter, a second substantially straight portion 28 extends radially inwardly and upwards from the horizontal (angle E_2, approximately 6.5^o). The second straight portion 28 is connected to the base 8 by a concave portion 30 (centre of curvature 32).

Figs. 6 and 7 are sectional views of the foot 10, perpendicular to the radial axis, on lines C-C and D-D respectively of Fig. 5. In these views, the foot is generally U-shaped, comprising an arc 34 (Fig. 6, 42 in Fig. 7) having centre of curvature 36 (44) which is radiused into the base by concave portions 38 (46) about

centres of curvature 40 (48). As can be seen from the drawings, the radius of curvature of the arc 34 reduces from the periphery of the base 8 towards the centre.

As has been described above, the use of a base portion which is less than semi-circular in section provides advantages in relation to the stability of the bottle and resistance to stress-cracking around the feet, whilst being reasonably resistant to distortion. In many practical applications however, the internal pressure on the bottle is great enough to distort the base, causing the centre portion of the base to expand downwards, and pushing the feet outwards. Eventually the bottom of the base will project below the feet so that the bottle will rock on its base. The configuration of the base can however, be modified in a number of ways to increase its resistance to distortion thereby allowing it to be used with liquids of higher pressure, as is shown in Figs. 8, 9 and 10.

Fig. 8 shows a bottle base 50 which is generally elliptical in section as before, having a fundamental radius R1, which is greater than the radius R2 of the cylindrical body of the bottle, centred at 52, and wherein the radius of the peripheral portions of the base 50, R3, is less than R2 and centred at points 54 and 56. Superimposed upon the elliptical base are first and second straight-line portions 58 and 60 symmetrically disposed opposite one another on either side of the long axis of the bottle.

Thus, in section, the base 50 comprises a first short peripheral arcuate portion PQ of radius R3, a first straight line portion QR, a bottom arcuate portion RS of radius R1, a second straight-line portion ST and a second short peripheral arcuate portion TU, radius R3. The base portion 50 is therefore generally ellipsoidal with an upwardly diverging frusto-conical portion superimposed

thereon. The introduction of the frusto-conical portion causes the forces exerted on the base by the internal pressure to be redistributed in such a way as to reduce the tendency of the bottom portion of the base to distort downwards. It is also possible to use more than one frusto-conical portion (ie. further pairs of straight-line portions disposed around the section of the base) and to vary their length and position on the base.

In this case the shape of the feet is not critical. As illustrated, the feet 62 are generally similar to that shown in Fig. 5 and the same broad principles apply.

An alternative means of strengthening the base is shown in Fig. 9 wherein the base portion 64 is elliptical in section (ie. R1 greater than R2; R3 less than R2) and the radially extending lower portion 66 of the foot 68 is extended further inwards towards the centre of the base. In this way, the feet of the bottle form a series if downwardly projecting "spurs" diverging radially from the centre of the base, effectively bracing it against distortion. As shown, the bottom portion 66 of the foot 68 comprises a straight-line portion tangent to the arcuate portion 70 and extending inwardly to merge with the bottom portion of the elliptical base. This shape of foot can of course be varied provided that its innermost termination is as close to the centre of the base as possible.

Fig. 10 shows a particularly preferred embodiment of the invention wherein the generally elliptical base portion 72 is provided both with a frusto-concial portion (defined by straight-line portions 74 and 76) and "spurs" formed by the feet 78 as described above. Again, the size, position and number of the frusto-conical portions and the particular shape of the feet may be varied.

Fig. 11 shows a further variation wherein the base

portion 80 is part-spherical having radius R4 greater than R1 so that the base portion 80 comprises an arc which joins the vertical side walls 82 without the transitional arcuate portions of an elliptical base.

Such a base has not hitherto been considered suitable for use with the pressurised liquids, but the provision of feet having inwardly extending "spurs" as described above enhances its resistance to deformation sufficiently for it to be of practical use for such applications. this base may also be provided with one or more frusto-conical sections as previously described (83. Fig. 12).

A further modification which may be incorporated into any of the embodiments hereinbefore described is an upwardly concave arcuate portion (84, shown in dotted lines in Fig. 12) located at the centre of the base. This provides further strengthening of the base.

Fig. 2 of the drawings shows the base as having nine feet 10. The number of feet may be varied, but it is preferred to have a large number (ie. in the range seven to twelve) of relatively small, closely spaced feet, since this provides a stronger structure than fewer, larger feet. An odd number of feet is also preferred since this tends to improve the stability of the bottle if there are slight variations in the size of feet. If the base includes a frusto-concical portion, fewer feet are required since the basic structure is inherently stronger. If "spurs" alone are used, a larger number of feet is preferable since they contribute directly to the strength of the base.

Preferred materials for the container are PET, PVC, polypropylene and polyethylene, including HDPE, LDPE and LLDPE.

Claims

1. A plastics container comprising a generally cylindrical body portion and a generally convex base portion closing the bottom of said body portion, said base portion having a plurality of stabilising feet projecting downwardly therefrom and spaced around the circumference thereof, wherein the fundamental radius of curvature of said base portion is greater than the radius of said body portion, and further including means for increasing the resistance of said base portion to deformation due to internal pressure, said means comprisng spurs, formed by the bottom surfaces of said stabilising feet, extending radially inwards towards the centre of said base portion and terminating at or adjacent to said centre and/or at least one frusto-conical portion superimposed upon said base portion.

2. A container as claimed in claim 1 comprising a generally cylindrical body portion and a generally convex base portion closing the bottom of said base portion, said base portion having a plurality of stabilising feet projecting downwardly therefrom and spaced around the circumference thereof, wherein the fundamental radius of curvature of said base portion is greater than the radius of said body portion, and further including means for increasing the resistance of said base portion to deformation due to internal pressure, said means comprising spurs, formed by the bottom surfaces of said stabilising feet, extending radially inwards towards the centre of said base portion and terminating at or adjacent to said centre.

3. A container as claimed in claim 1 comprising a generally cylindrical body portion and a generally convex base portion, said base portion having a plurality of stabilising feet projecting downwardly therefrom and spaced around the circumference thereof, wherein the

fundamental radius of curvature of said base portion is greater than the radius of said body portion, and further including means for increasing the resistance of said base portion to deformation due to internal pressure, said means comprising at least one frusto-conical portion superimposed upon said base portion.

4. A container as claimed in claim 1 or claim 2 wherein said bottom surfaces of said spurs each comprise, in radial cross-section, a generally straight-line portion extending radially inwards and merging with said generally convex base portion adjacent the centre thereof.

5. A container as claimed in claim 1 or claim 3 wherein said base portion, in transverse cross-section comprises a generally arcuate convex wall and each of said frusto-conical portions comprises a pair of straight-line portions disposed symmetrically about the central axis of the container, superimposed upon said convex wall.

6. A container as claimed in any preceding claim wherein said base portion, in transverse cross-section, is generally part-elliptical, having a bottom arcuate portion of radius greater than the radius of said body portion and first and second peripheral arcuate portions of radius less than the radius of said body portion.

7. A container as claimed in any of claims 1 to 5 wherein said base portion, in transverse cross-section, is generally part-circular, comprising an arc of radius greater than the radius of said body portion.

8. A container as claimed in any preceding claim further including an upwardly concave portion located at the centre of said base portion.

9. A container as claimed in any preceding claim, wherein said stabilising feet are generally U-shaped in section perpendicular to their radial axis and radiused into said base portion.

10. A container as claimed in any preceding claim

wherein the number of said stabilising feet is in the range 7 to 12.

11. A container as claimed in claim 10 wherein the the number of said stabilising feet is an odd number.

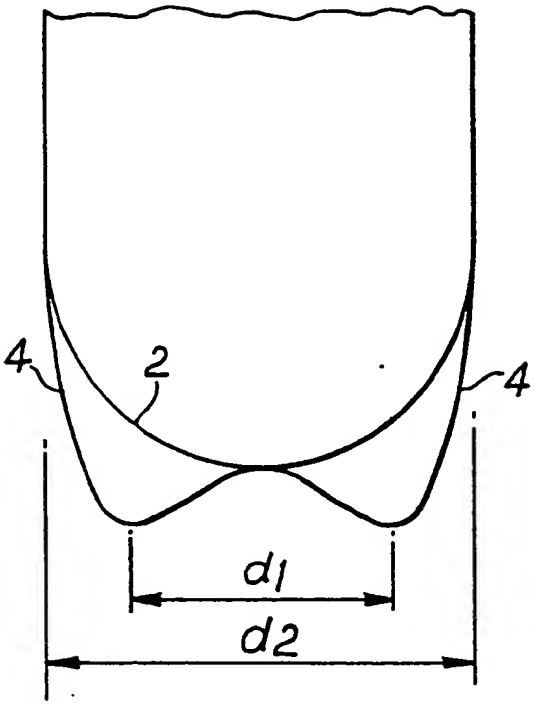

Fig. 1

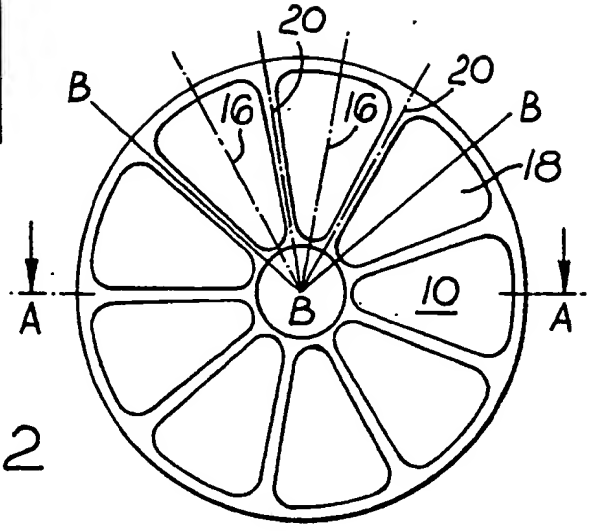

Fig. 2

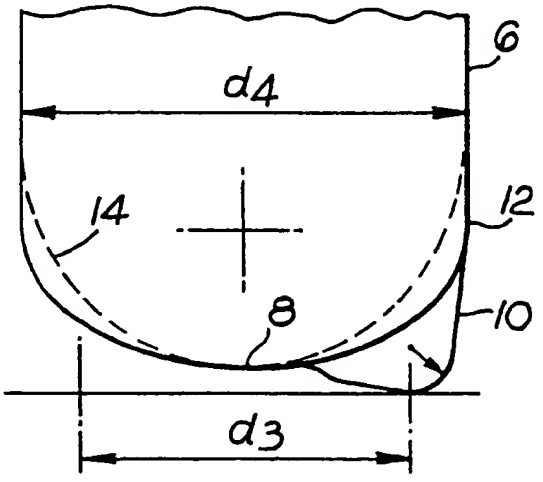

Fig. 3

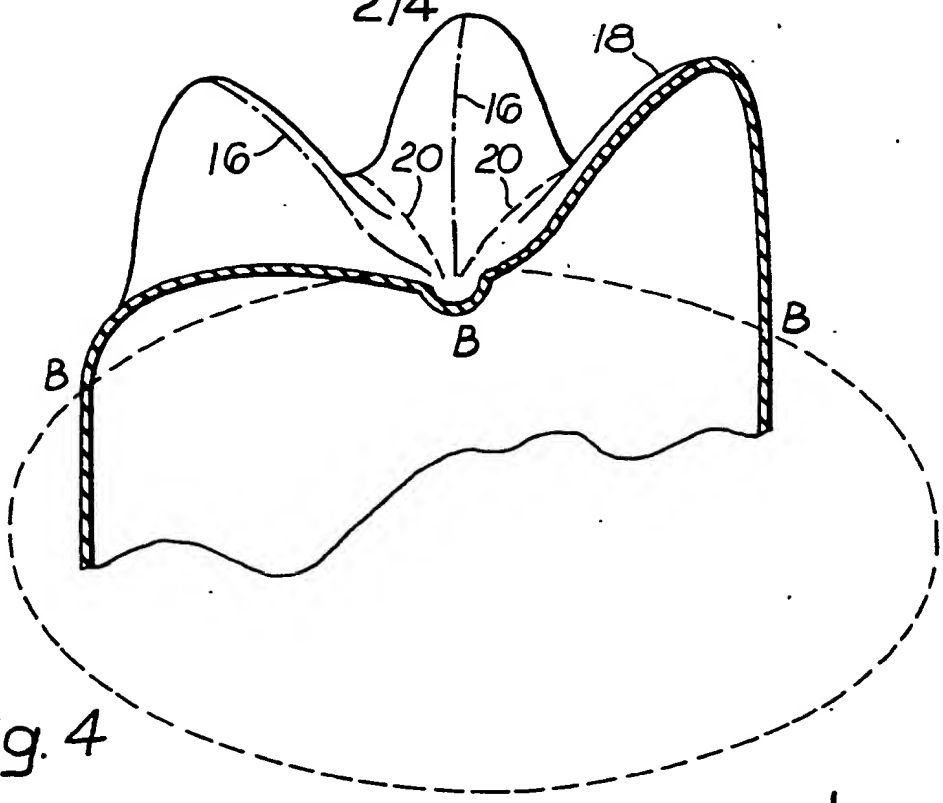

Fig. 4

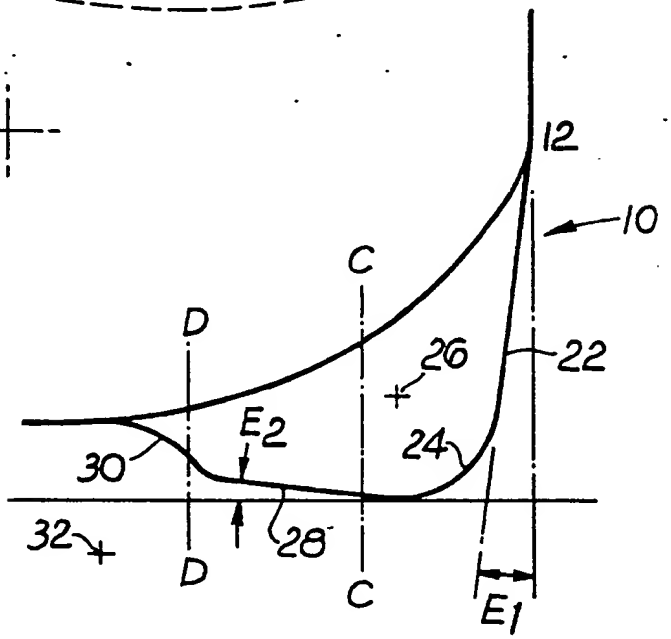

Fig. 5

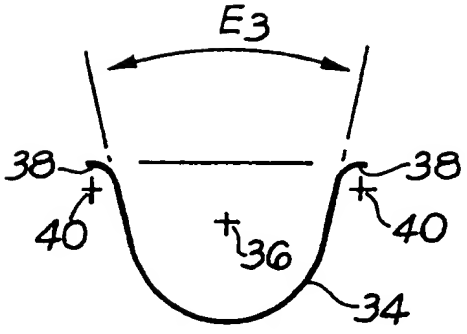

Fig. 6

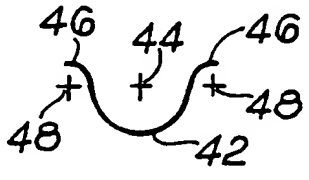

Fig. 7

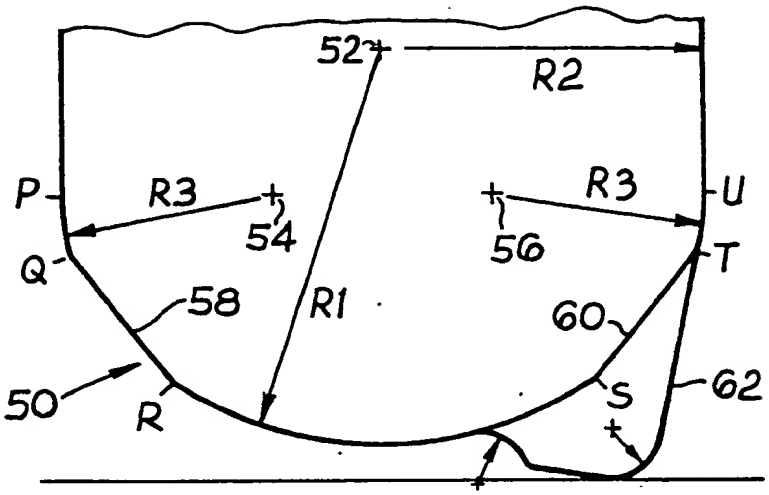

Fig. 8

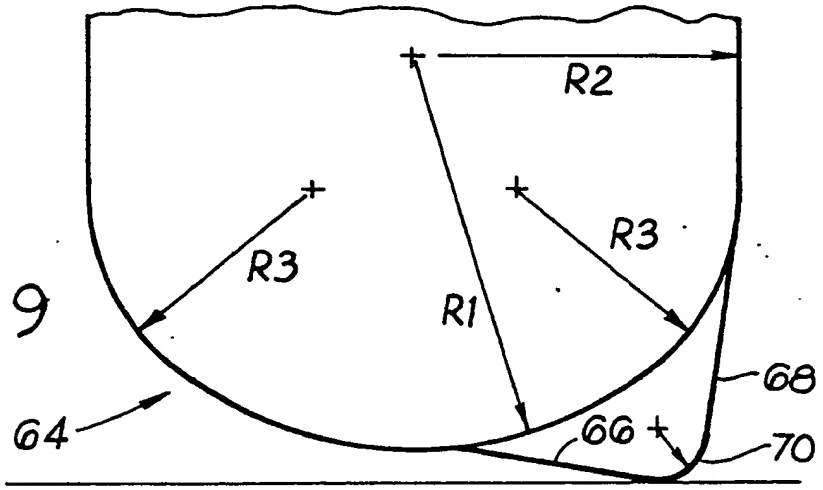

Fig. 9

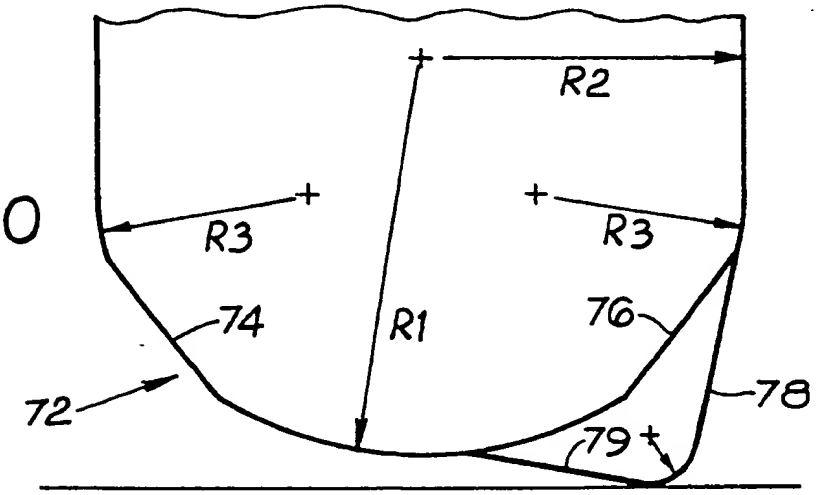

Fig. 10

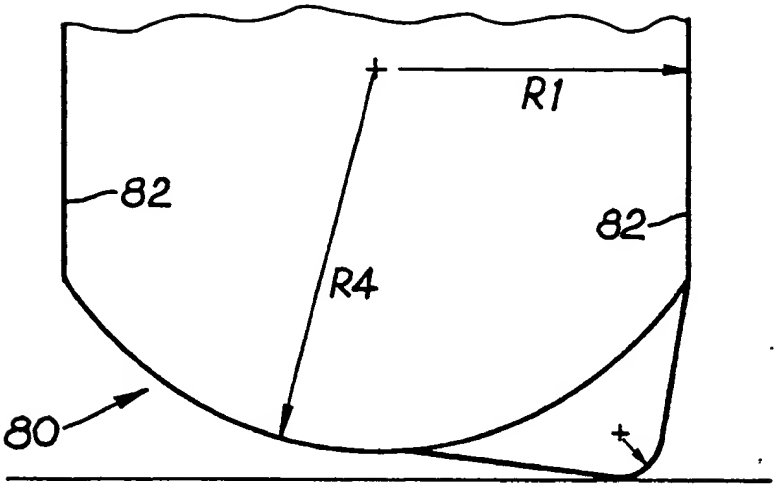

Fig. 11

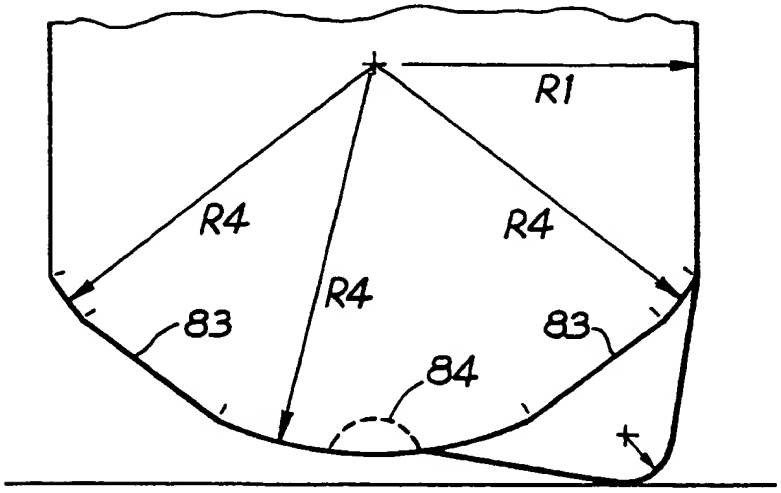

Fig. 12

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 86/00160

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 65 D 1/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 65 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4249667 (CONTINENTAL GROUP) 10 February 1981, see figures 5-9	1-3,5-8
X	DE, A, 2920122 (VOITH FISCHER) 20 November 1980, see the whole document	1,2,4,6, 7,9
A		3,11
A	FR, A, 2446228 (YOSHINO KOGYOSHO) 8 August 1980, see figures 1,2	10

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
10 juin 1986	10 JUIL. 1986
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. VAN MOL

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 86/00160 (SA 12580)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 24/06/86

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 4249667	10/02/81	EP-A-	0028125	06/05/81
		JP-A-	56106740	25/08/81
		AU-A-	6369280	30/04/81
		AU-B-	518048	10/09/81
		CA-A-	1157786	29/11/83
DE-A- 2920122	20/11/80	None		
FR-A- 2446228	08/08/80	AU-A-	5363379	07/08/80
		JP-A-	55095602	21/07/80
		AU-B-	522123	20/05/82
		CA-A-	1135203	09/11/82
		JP-A-	55094968	18/07/80
		US-A-	4352435	05/10/82
		US-A-	4355728	26/10/82
		JP-A-	55101009	01/08/80